

Visualization Tools for Opacity Analysis

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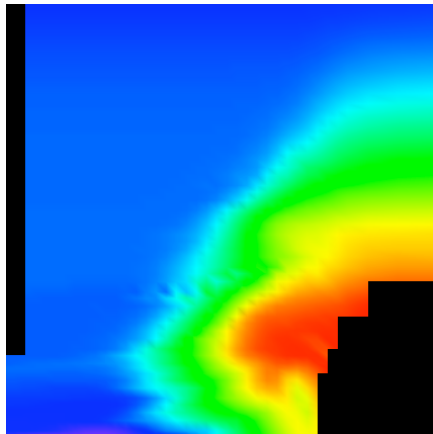
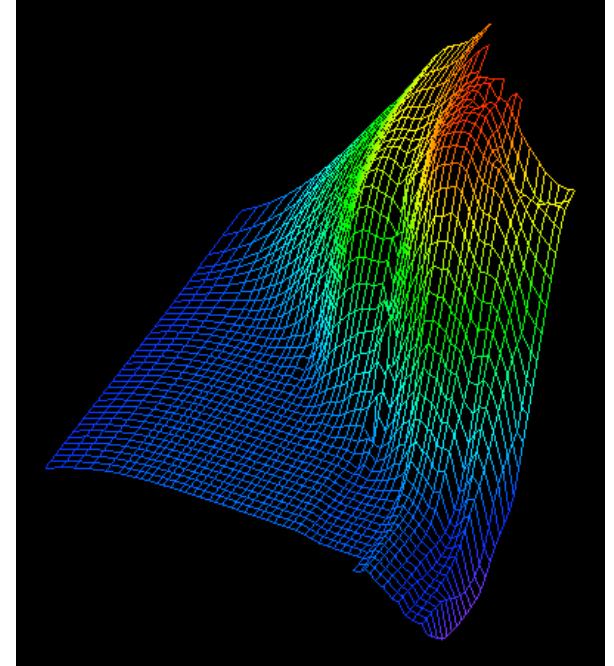
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Introduction to Opacity Visualization

- The need for opacity visualization
 - investigation of new opacity tables (ATOMIC)
 - comparison of codes
 - reduce the learning curve
 - graphical user interface will facilitate studies into the deep details of opacity code output
 - IDL Virtual Machine allows anyone to run the program without having to purchase IDL



Main goal of this opacity visualization project:

Build an easy-to-use yet sophisticated tool to allow the T-4 opacity group to 'diagnose' their opacity tables.



Data for Visualization

- Many physical quantities are output from ATOMIC
 - Opacities
 - Rosseland
 - Planckian
 - Conductive
 - Rosseland + Conductive
 - Planckian + Conductive
 - Z-bar
 - Ion density, electron density
 - Mass density
 - Total internal energy
 - five individual contributions
 - Total pressure
 - five individual contributions
 - Debye radius
 - Plasma frequency

- **Data come in the form of individual files for each point in the table.**
- **The independent variables are η (function of density and temperature) and θ (temperature).**
- **HDF files are used to organize the data.**



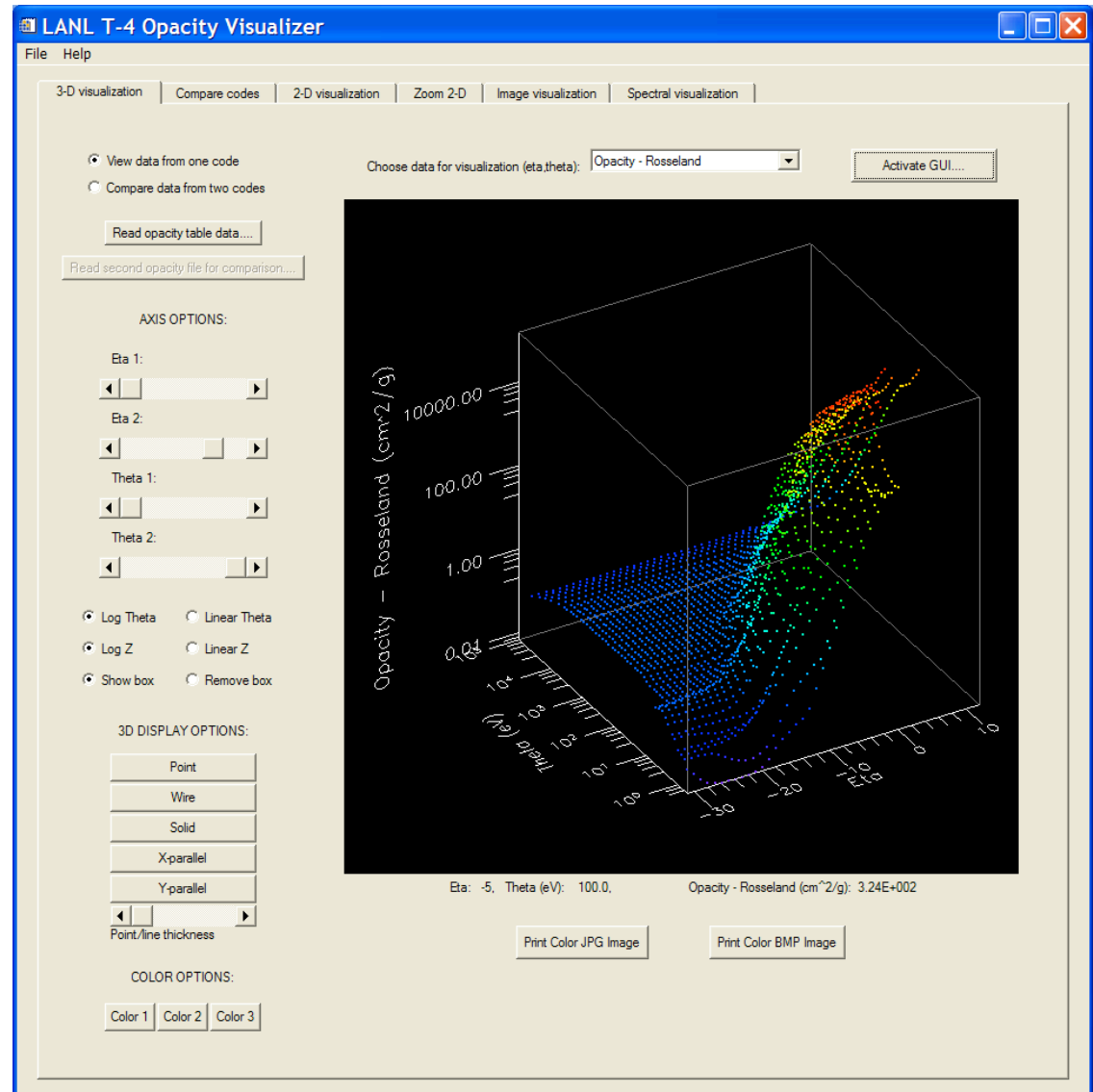
Important Needs

- Graphical user interface built in IDL (Interactive Data Language)
 - tab layout: simple straightforward interface with room for later additions and improvements
 - 'crash-proof': buttons, droplists, slider bars, and windows become active only when the input data becomes available
 - no set order of operations: users can flip between tabs and change previous choices
- 3-d capability
 - visualization of surfaces as a function of η and θ
 - object-oriented programming allows plot rotation and manipulation
- 2-d capability
 - selection of regions of interest for 2-d representation
 - zooming and printing possibilities
- Capability to visualize spectra
 - allows comparison of three spectra from specific points in the table

3-d Visualization of Opacity Table Output

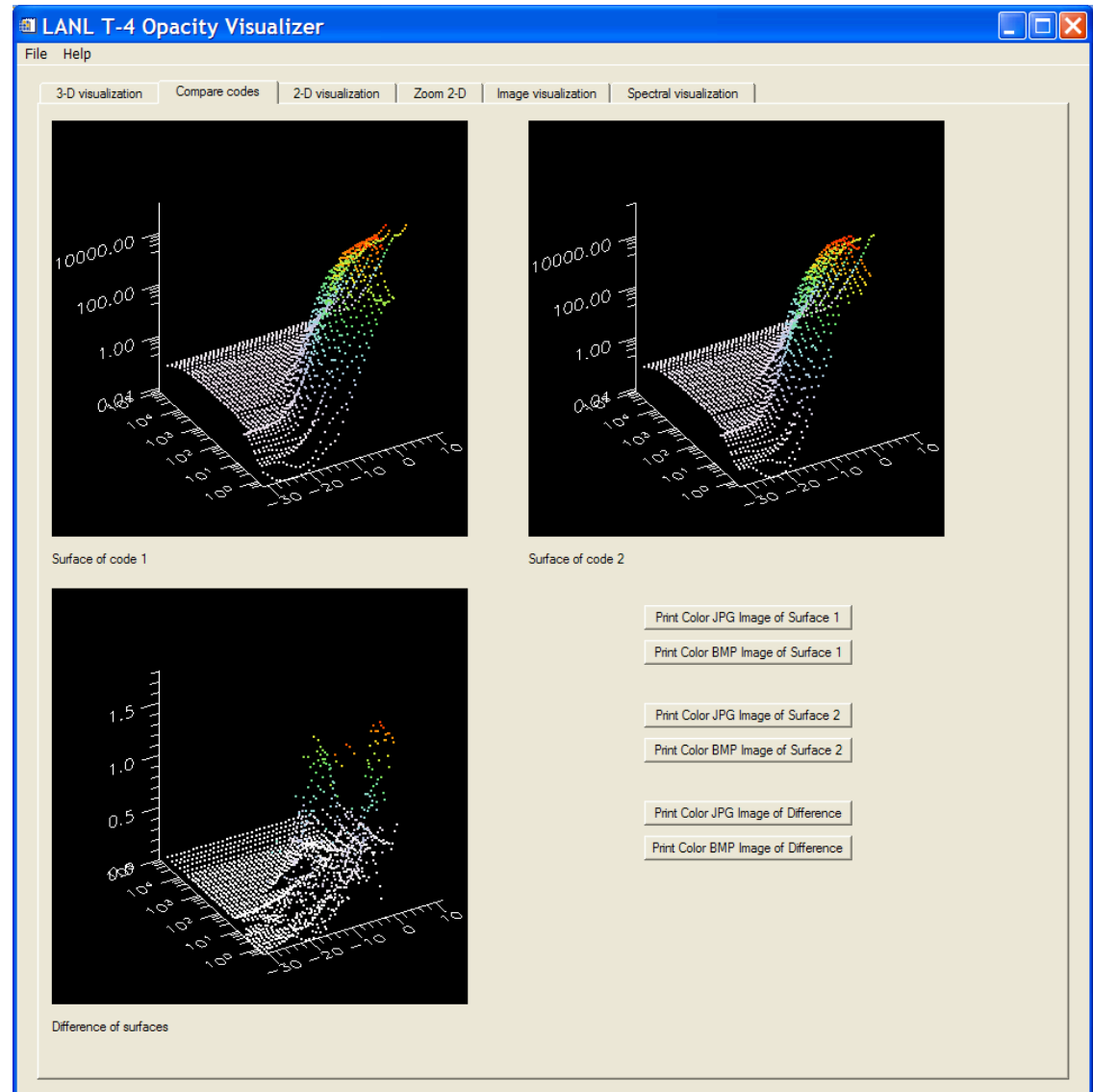
■ Main 3-d tab

- read in data (from 1 or 2 codes)
- data selected in droplist is the 'active' dataset
- rotate 3-d surface
- mouse position on surface gives data point
- change η and θ range
- specify log or linear axes
- show or remove 3-d box
- options for display
- color options
- example: Rosseland opacity as a function of η and θ



Comparison of Codes

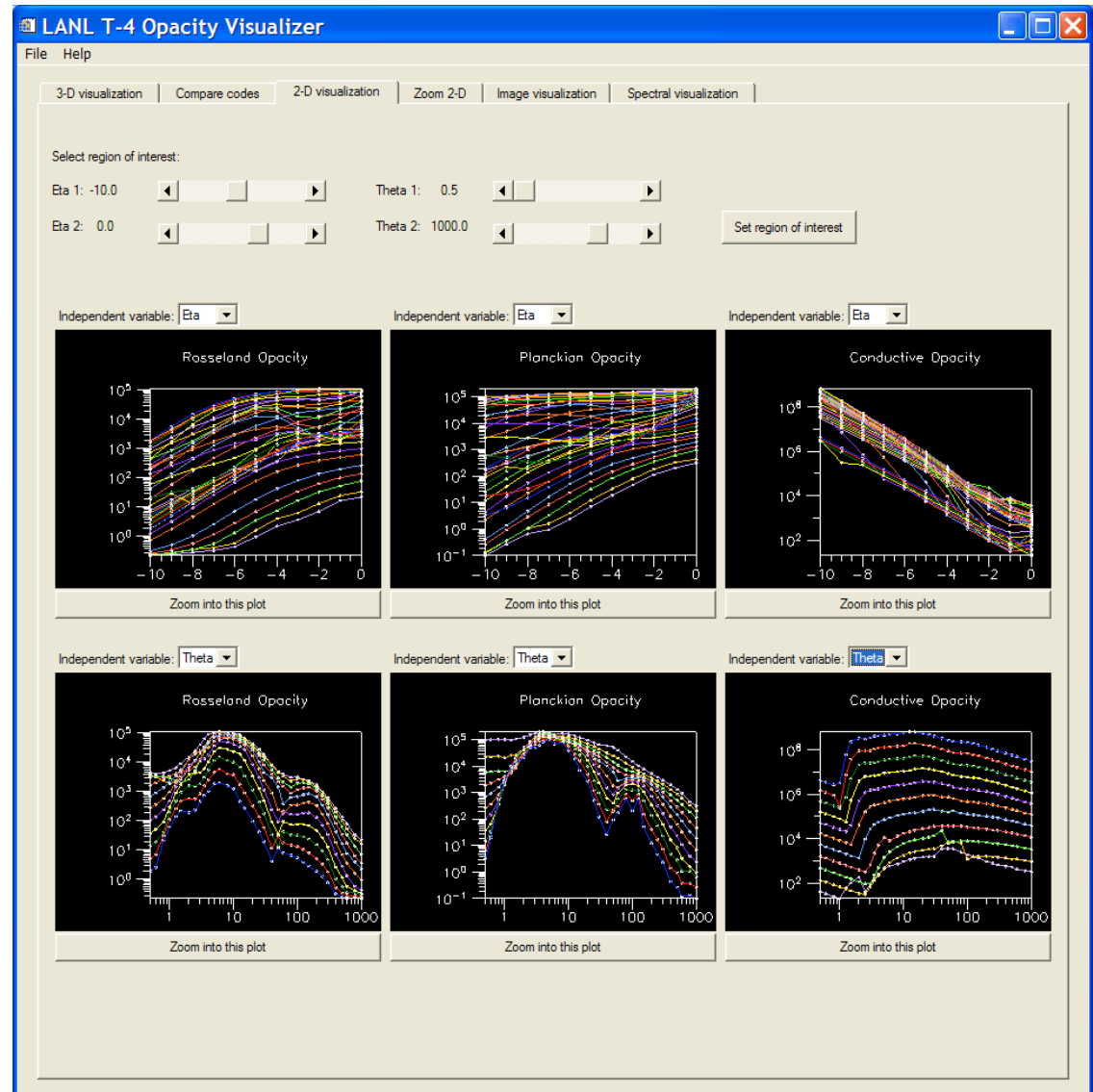
- Code comparison tab
 - view 3-d surfaces of two datasets side-by-side
 - view surface which represents difference between the two codes
 - print color JPG and BMP images



2-d Visualization of Opacity Table Output

■ 2-d tab

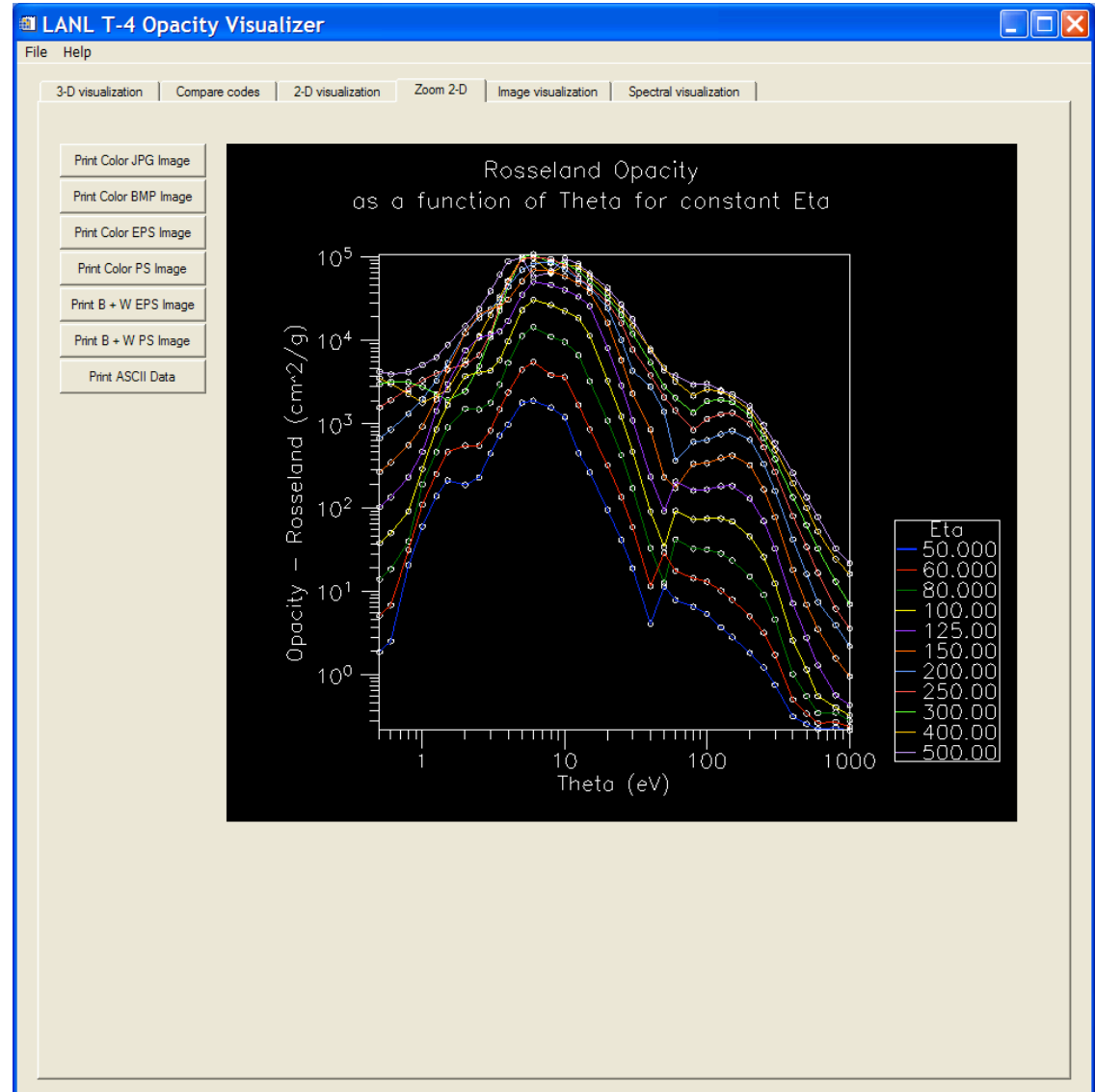
- select a 'region of interest' with η and θ slider bars
- six small 'snapshots' allow active dataset to be displayed
- best used for a quick survey of the data
- each snapshot can be zoomed into
- example: different opacities as a function of either η or θ for constant θ or η



Zooming and Printing Capability

■ Zoom 2-d tab

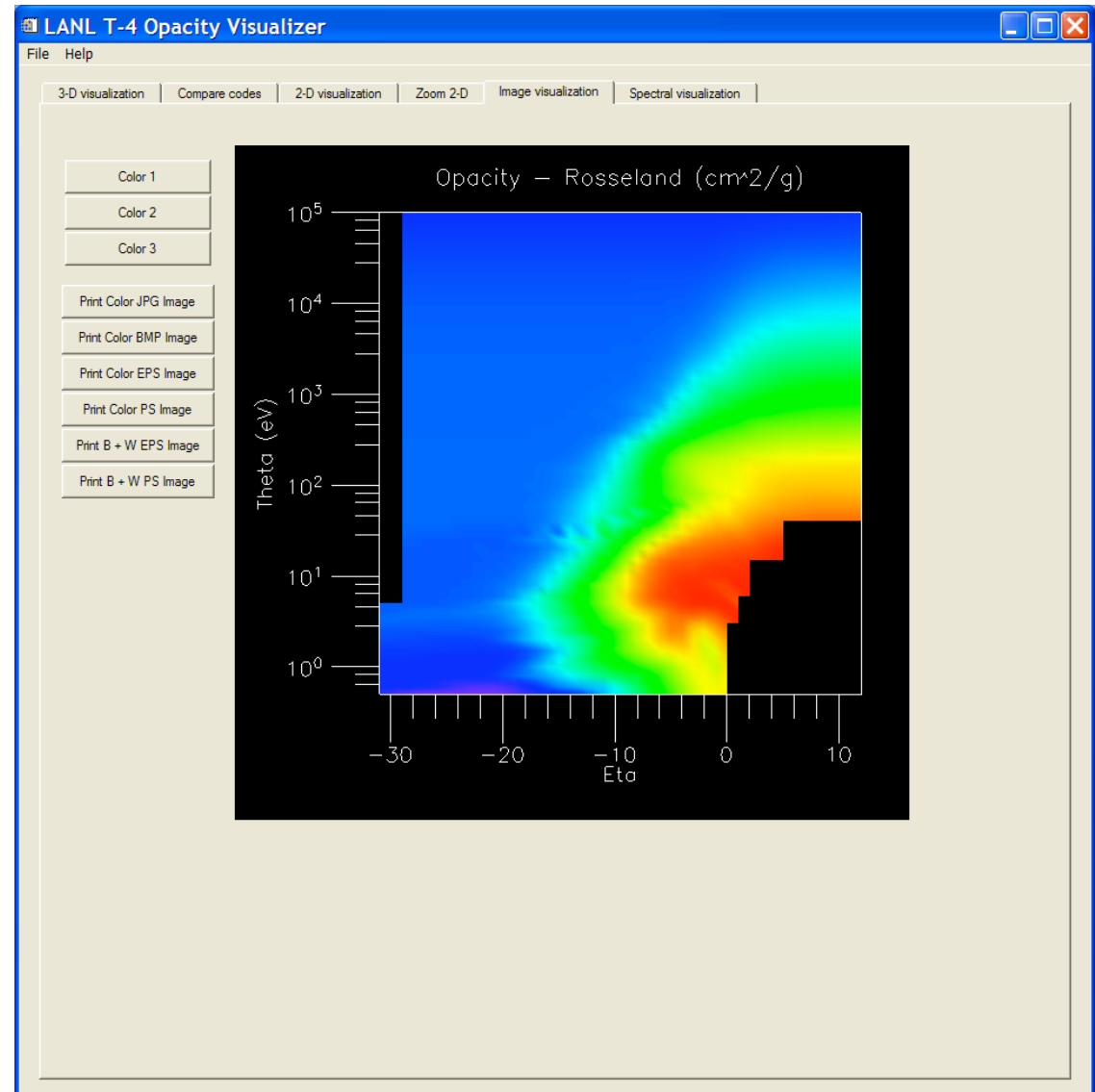
- larger and better quality plots
- axis range is same as on 2-d tab
- legend provides info on iso- η or iso- θ
- printing capability for JPG, BMP, EPS, and PS files (white background)



Surface Image Visualization

■ Image tab

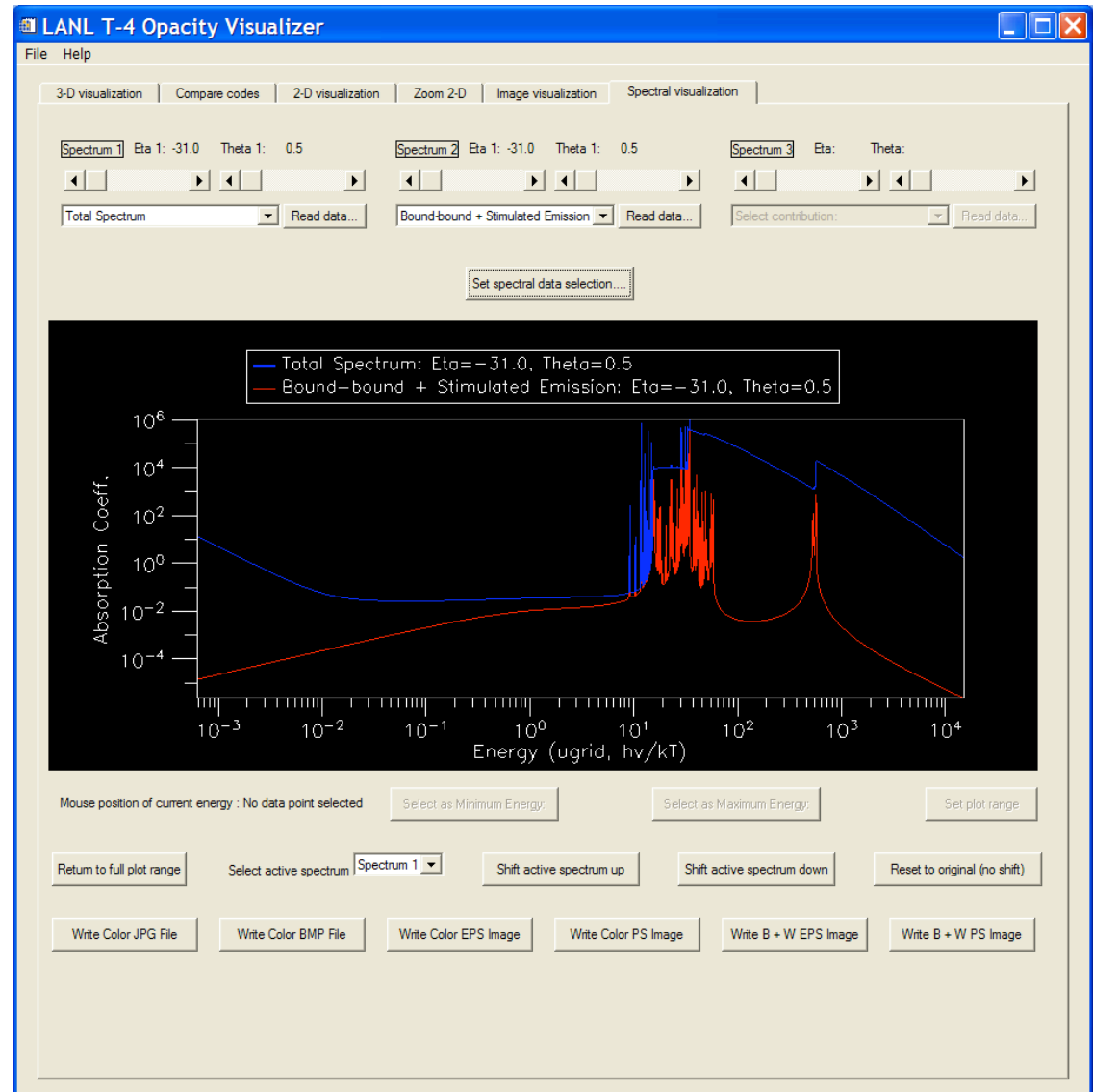
- visualization of active dataset (looking down on surface)
- helps to see missing points in the table
- color scheme can be changed
- printing capability for JPG, BMP, EPS, and PS files



Visualization of Spectra

■ Spectra tab

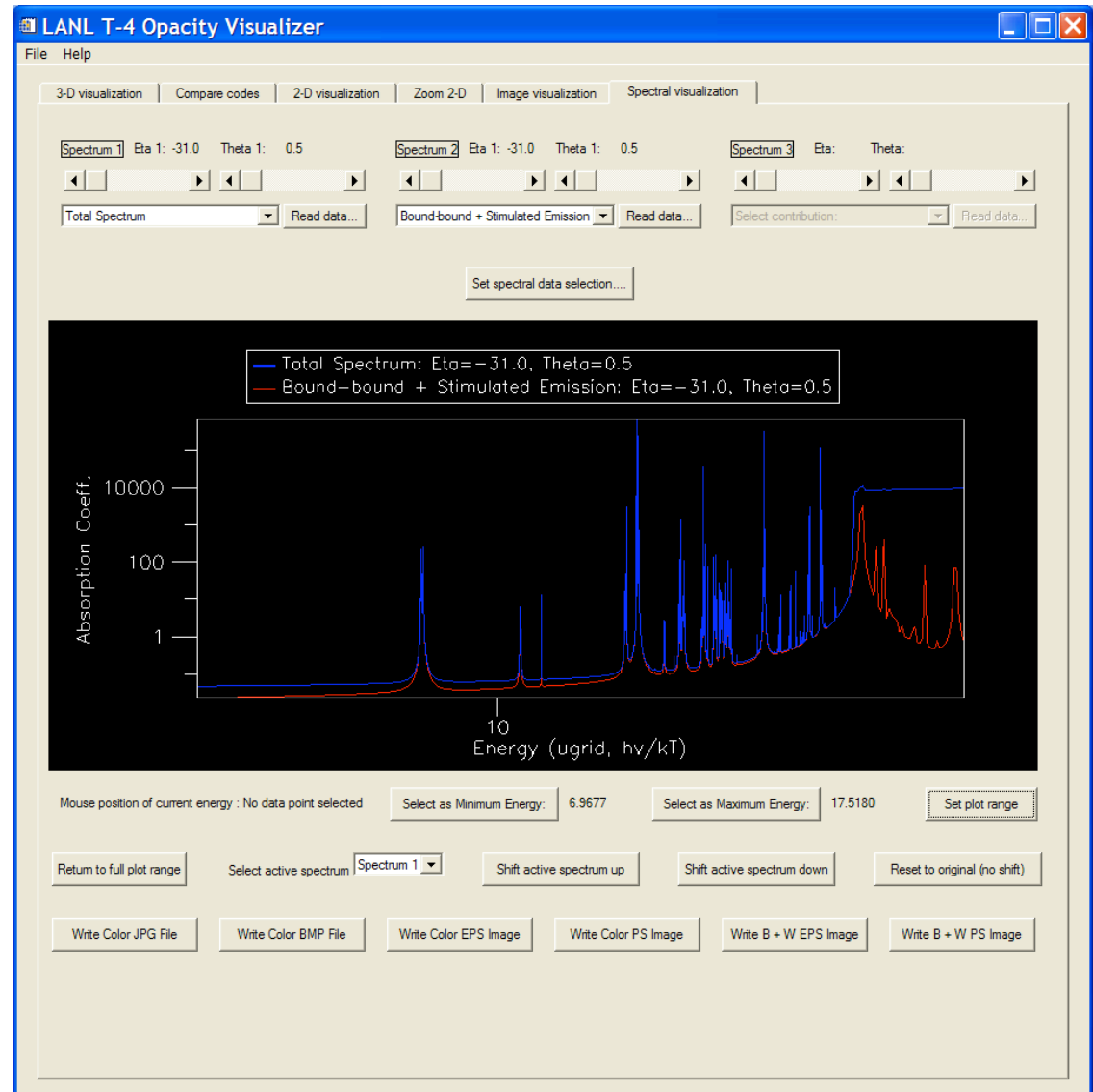
- choose up to three individual data points with associated spectra
- can compare spectral contributions from the same point, or the same contribution from different points
- capability to compare spectra generated by other codes
- printing capability for JPG, BMP, EPS, and PS files



Visualization of Spectra

■ Spectra tab

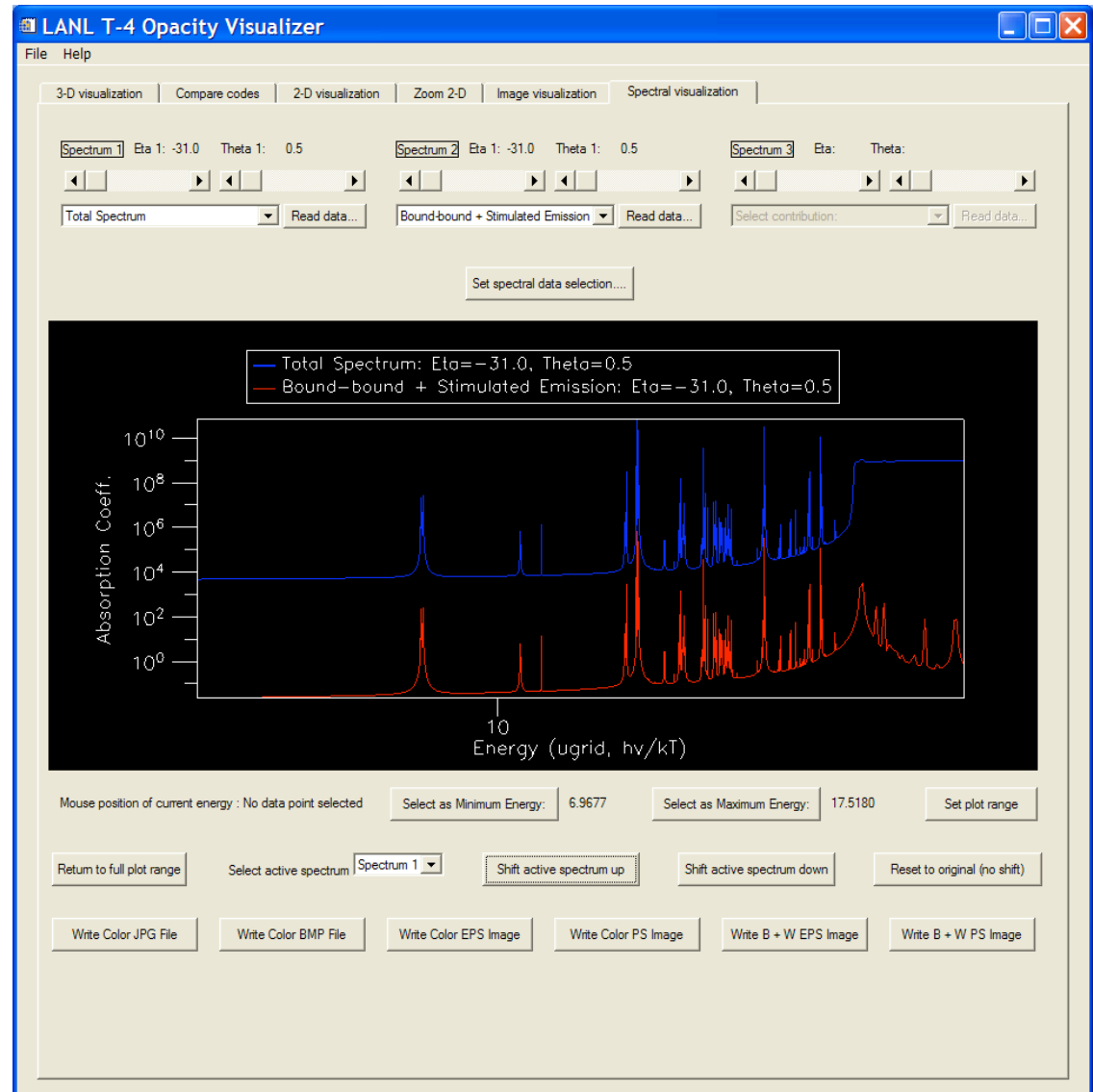
- example: zoom into region of interest
- can reset to full plot range



Visualization of Spectra

■ Spectra tab

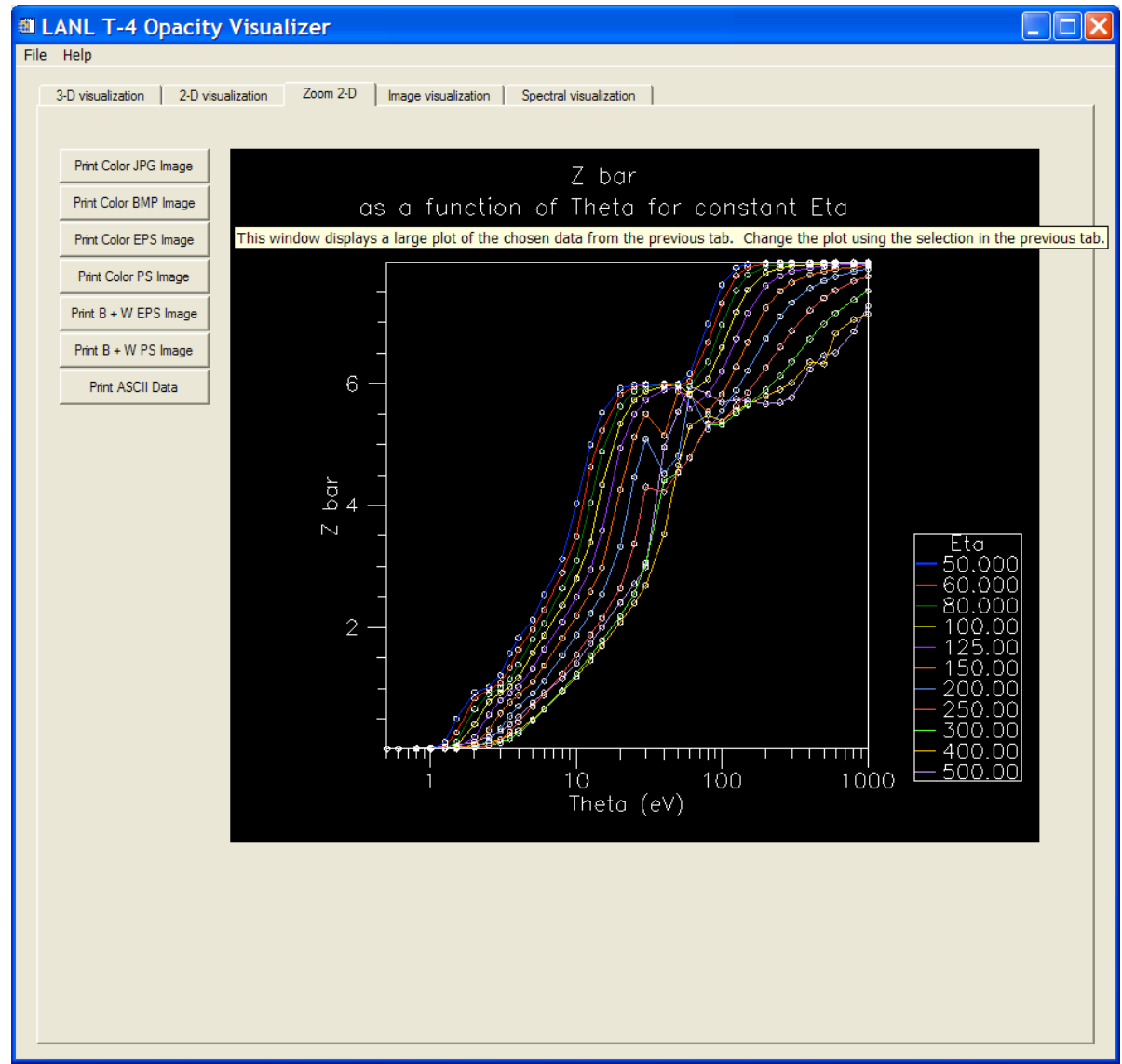
- example: select active spectrum and shift it up or down for easier comparison
- can reset to original case with no shift



Documentation and Help

■ Help options

- documentation in the form of a PDF file
- tooltip tutorial
- contact information
- version information





Conclusion and Future Work

- Capabilities to expand
 - expand ability to compare two datasets from two different codes
 - improve printing ability with more options
 - create interactive help menu

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Build an easy-to-use yet sophisticated tool to allow the T-4 opacity group to 'diagnose' their opacity tables.

Adapt the tool for outside use on the T-4 opacity webpage.